60 Rec'd PCT/PTO 10 OCT 2000

FORM PTO-1390 (REV 5-93)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY DOCKET NO. P100806-00001
	TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	DATE: October 10, 2000
		U.S. APPLN. NO. (IF KNOWN, SEE 37 CFR 1.5) 09/646906

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/JP99/02360	April 30, 1999	May 15, 1998

TITLE OF INVENTION: MOUNT STRUCTURE FOR THERMAL FUSE ON CIRCUIT BOARD

APPLICANT(S) FOR DO/EO/US: Mitsunori NAGASHIMA

1. XX This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
(THE BASIC FILING FEE IS ATTACHED)

2. __ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. XX This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT articles 22 and 39(1).

4. __ A proper demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. XX A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. __ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. XX has been transmitted by the International Bureau.
   c. __ is not required, as the application was filed in the United States Receiving Office (RO/US)

6. XX A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. __ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. __ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. __ have been transmitted by the International Bureau.
   c. __ have not been made; however, the time limit for making such amendments has NOT expired.
   d. __ have not been made and will not be made.

8. __ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. XX An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. XX A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
(Amendment Under Article 34)

Items 11. to 16. below concern other document(s) or information included:

11. XX An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. XX An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. __ A FIRST preliminary amendment.
__ A SECOND or SUBSEQUENT preliminary amendment.

14. __ A substitute specification.

15. __ A change of power of attorney and/or address letter.

16. XX Other items or information:
Check No. 302257
Drawing(s) 3 sheets
International Search Report
Notification of Receipt of Record Copy (PCT/IB/301)
Notification Concerning Submission of Priority Documents (PCT/IB/304)
Notice Informing the Applicant of the Communication of the International Application to the Designated Offices (PCT/IB/308)
Information Concerning Elected Offices Notified of Their Election (PCT/IB/332)
International Publication No. WO99/60828

U.S. APPLN. NO. (IF KNOWN, SEE 37 C.F.R. 1.50) 09/646906	INTERNATIONAL APPLICATION NO. PCT/JP99/02360	ATTORNEY DOCKET NO. P100806-00001 DATE: October 10, 2000

17. XX The following fees are submitted:
Basic National Fee (37 CFR 1.492(a)(1)-(5):
Search Report has been prepared by the EPO or JPO.....$860.00
International preliminary examination fee paid to USPTO (37 CFR 1.482)....$690.00
No international preliminary examination fee paid to USPTO (37 CFR1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))....$760.00
Neither international preliminary examination fee (37 CFR 1.482) or international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....$1,000.00
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....$ 96.00

	CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than _ 20 _ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		

Claims	Number Filed	Number Extra	Rate		
Total Claims	4 - 20 =	0	X $ 18.00		
Independent Claims	1 - 3 =	0	X $ 80.00		
Multiple dependent claim(s) (if applicable)			+ $270.00		
TOTAL OF ABOVE CALCULATIONS =				$ 860.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).					
SUBTOTAL =				$ 860.00	
Processing fee of $130.00 for furnishing the English translation later the _ 20 _ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +					
TOTAL NATIONAL FEE =				$ 860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$ 40.00	
TOTAL FEES ENCLOSED =				$ 900.00	
				Amount to be refunded	$
				Charged	$

a. XX A check in the amount of $ 900.00 to cover the above fees is enclosed.
b. __ Please charge my Deposit Account No. 01-2300 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. XX The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 01-2300 .

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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3/parts.

SPECIFICATION

Mount Structure for Thermal Fuse on Circuit Board

Technical Field

The present invention relates to a structure for mounting a thermal fuse on a circuit board, for example, a structure for mounting an axial type thermal fuse on a circuit board placed in a small space like a circuit board contained in a battery casing of a notebook computer or the like. More specifically, the invention relates to a structure for mounting a thermal fuse on a circuit board in which the thermal fuse is attached to sensitively detect the temperature of any component as its temperature increases and which enables reduction of the total thickness of the circuit board including mounted components.

Background Art

A battery casing of a notebook computer contains, as shown in Fig. 2 for example, a rechargeable battery such as lithium ion battery or the like encased in a battery housing 22 in a resin case 21. In a narrow space between battery housing 22 and an end of resin case 21, an electric circuit board 23 is housed. Electric circuit board 23 has components formed thereon such as a protection circuit for preventing overcharge of the rechargeable battery as well as explosive breakdown due to short-circuit.

Onto circuit board 23, a thermal fuse is integrated in the vicinity of any electronic component such as FET which readily generates heat when overcurrent flows due to occurrence of abnormality on a circuit. Circuit board 23 is thus provided with means for preventing such an accident by breaking the circuit when the temperature abnormally increases.

In a conventional mount structure for a circuit board having such a thermal fuse, as shown in Figs. 3A and 3B for example, a silicone resin 33 is applied onto a board 31 to reach an FET 32 thereby facilitate heat conduction from FET 32 which readily generates heat. An axial type thermal fuse 34 is mounted on silicone resin 33 to be embedded therein and

connected in series to the circuit. Therefore, when viewed from the side of thermal fuse 34, silicone resin 33 is higher than thermal fuse 34 while thermal fuse 34 is surrounded by silicone resin 33 with the upper surface of thermal fuse 34 being exposed.

As discussed above, in the conventional mount structure having the thermal fuse integrated onto the circuit board, the silicone resin for temperature transmission is applied onto the board, the thermal fuse is mounted on the silicone resin and accordingly, the thickness (H in Fig. 3B) from the board increases.

A resultant problem is, for such a use as the one which requires the thickness H from the board to be 4 mm or less like a thin circuit board or the like used for the battery casing of the notebook computer described above, a considerable difficulty in dimensioning the circuit board in such a range because the diameter D of the thermal fuse is approximately 2 mm, leading to deterioration of working efficiency.

The entire thickness could be reduced by decreasing the thickness of board 31. However, currently the board is approximately 0.8 mm in thickness, and further thinning of the board would cause warp thereof. Consequently, the mounting work becomes troublesome in manufacture and the cost of the board increases.

The present invention is made to solve these problems. One object of the invention is to provide a mount structure for a thermal fuse on a circuit board, which enables reduction of the thickness to the surface of mounted components without thinning the board, allows a thermal fuse to be mounted on a circuit board housed in a considerably small space such as the one in a notebook computer, and further enables circuit to be broken surely when any abnormality occurs by sensitively detecting the temperature of any component which is likely to increase in temperature.

Disclosure of the Invention

According to the present invention, a mount structure for thermal fuse on circuit board includes a circuit board, a through opening, an electronic component and a thermal fuse. The circuit board has one

surface on which a predetermined circuit is formed. The through opening is provided in the circuit board. The electronic component is attached to the one surface of the circuit board to extend across the through opening. The thermal fuse is provided on the other surface of the circuit board to enter the through opening, responding to the temperature of the electronic component via a heat-conducting insulating member filling the through opening for breaking the predetermined circuit. In particular, the electronic component here refers to an electronic component such as power FET for example having its temperature remarkably increased when any abnormality such as overcurrent occurs.

In this structure, the electronic component is attached to one surface of the circuit board to extend across the through opening provided in the circuit board, and for this particular electronic component, the thermal fuse is provided on the other surface of the circuit board to enter the through opening. In this way, it is possible to reduce the thickness of the entire assembly. The temperature of the electronic component is conducted to the thermal fuse via the heat-conducting insulating member filling the through opening. Accordingly, any temperature increase of the particular electronic component can be monitored sensitively, which ensures breaking of the circuit in the event of temperature increase.

Specifically, the heat-conducting insulating member described above is preferably silicone resin.

Preferably, a through hole is provided in the circuit board and the thermal fuse is electrically connected to the predetermined circuit via the through hole.

In this case, the thermal fuse attached to the other surface of the circuit board can readily be connected to the circuit formed on one surface of the circuit board.

Further, the thermal fuse preferably includes therein a rod-shaped fuse.

In this case, depending on use or heat-conducting state between the fuse and the electronic component, the diameter of the rod-shaped fuse can be changed to easily control the temperature at which the circuit is to be

broken.

Brief Description of the Drawings

Fig. 1A is a plan view illustrating a structure for mounting a thermal fuse on a circuit board according to the present invention.

Fig. 1B is a transverse cross section along IB-IB in Fig. 1A.

Fig. 1C is a longitudinal cross section along IC-IC in Fig. 1A.

Fig. 1D is a rear view illustrating the structure for mounting the thermal fuse on the circuit board according to the present invention.

Fig. 2 is a perspective view illustrating one example of a battery casing of a notebook computer.

Fig. 3A is a plan view illustrating a conventional structure for mounting a thermal fuse on a circuit board.

Fig. 3B is a longitudinal cross section along IIIB-IIIB in Fig. 3A.

Best Modes for Carrying Out the Invention

Referring to the drawings, description is now given of a structure for mounting a thermal fuse on a circuit board according to the present invention. As shown in Figs. 1a to 1d, in the mount structure for a thermal fuse on a circuit board according to the invention, an electronic component is integrated onto the surface of a board 1 where an interconnection pattern (not shown) is formed. It is noted that other electronic components are not shown in the drawings. In the vicinity of a particular one of these electronic components that readily generates heat, an FET 2 for example, a thermal fuse 4 is provided to break circuit when the temperature of the electronic component increases.

According to the present invention, a through opening 1a is provided in board 1 such that it is located at the portion where the particular electronic component (FET) 2 is placed. FET 2 is attached to the front surface of board 1 to extend across through opening 1a. On the rear side of FET 2, thermal fuse 4 is attached to partially enter through opening 1a via a heat-conducting resin 3 such as silicone resin, for example.

A lead 5 on either end of thermal fuse 4 is connected from the rear

surface of board 1 to an interconnection (not shown) formed on the front surface of board 1 via a through hole 1b provided in board 1.

For circuit board 1, a printed board or the like may be used that is formed of epoxy, glass epoxy, paper epoxy or the like for example and has interconnection printed on its surface. Through hole 1b for inserting therein a lead of any electronic component such as thermal fuse as well as through opening 1a are collectively punched by using a mold. Through opening 1a is provided in advance under the location where FET 2, a particular electronic component which readily increases in temperature, is to be mounted.

Usually board 1 having a thickness of approximately 0.8 mm is used, maintaining a sufficient mechanical strength without warp. A solder paste is applied onto a joint between the electronic component and the interconnection printed on the surface of circuit board 1. On this solder paste, the electronic component such as FET 2 of surface-mount type is placed. The electronic component is mounted accordingly by means of soldering in a reflow furnace or the like.

FET 2 is provided for switching on/off a charge/discharge circuit and is likely to generate heat when overcurrent flows due to any failure. This structure accordingly provides thermal fuse 4 near FET 2 so as to sense the generated heat and break the circuit in the event of heat generation.

For heat-conducting resin 3 as a heat-conducting insulating member, silicone resin or the like may be used similar to the one which has conventionally been employed. Heat conduction is improved by interposing the heat-conducting resin between the electronic component and the thermal fuse. Since thermal fuse 4 is inserted into heat-conducting resin 3 to be embedded therein, heat-conducting resin 3 extends even over the side of thermal fuse 4.

Thermal fuse 4 is of a columnar axial type including therein a rod-shaped fuse, and capable of controlling the temperature for breaking by changing the diameter of the rod-shaped fuse depending on the heat-conduction state between fuse 4 and any heat source. For example, a fuse applied to the battery casing of the notebook computer discussed above is

the one which breaks the circuit when the temperature rises to approximately 130℃, for example.

In the mount structure for a thermal fuse according to the invention, through opening 1a is provided in board 1 under the particular electronic component (FET) 2 with its temperature increase monitored, and thermal fuse 4 is mounted to partially enter through opening 1a via heat-conducting resin. Then, thermal fuse 4 can directly monitor increase of the temperature of the particular electronic component FET 2 in a sensitive manner.

Further, thermal fuse 4 is provided to partially enter through opening 1a formed in the board. Consequently, the thickness of the entire board including mounted components is considerably reduced. The height from the board is 1.3 mm or less and accordingly the entire thickness including the board is approximately 4 mm.

Since heat-conducting resin 3 fills the inside of through opening 1a, just an extremely small amount thereof is required. Reduction of the amount of applied resin is thus possible and the applying work is made considerably easier. In addition, there is no need to reduce the thickness of the board, which prevents any problem regarding warp of the board or the like. In this way, working efficiency improves and rising of cost is avoided.

Although silicone resin is used here as an exemplary heat-conducting resin, the resin is not limited to the silicone resin and any insulating material may be used if it has a property of conducting heat generated from an electronic component.

The embodiments herein disclosed should be considered as illustration and example in all respects, not to be taken by way of limitation. It is intended that the scope of the invention is defined not by the description above but by the scope of claims and that all modifications are included therein within the meaning and scope equivalent to the scope of claims.

As heretofore discussed, according to the present invention, when the mount structure for a thermal fuse on a circuit board is applied to mounting

of a thermal fuse on a circuit board which should be mounted in a considerably small space as the one in a notebook computer or the like, the mount structure ensures monitoring of temperature increase of a particular electronic component without increase of the thickness.

CLAIMS

1. A mount structure for thermal fuse on circuit board, comprising:

a circuit board having one surface where a predetermined circuit is formed;

a through opening provided in said circuit board;

an electronic component attached to the one surface of said circuit board to extend across said through opening; and

a thermal fuse provided on the other surface of said circuit board to enter said through opening, responding to temperature of said electronic component via a heat-conducting insulating member filling said through opening for breaking said predetermined circuit.

2. The mount structure for thermal fuse on circuit board according to claim 1, wherein

said heat-conducting insulating member is silicone resin.

3. The mount structure for thermal fuse on circuit board according to claim 1, including a through hole provided in said circuit board, wherein

said thermal fuse is electrically connected to said predetermined circuit via said through hole.

4. The mount structure for thermal fuse on circuit board according to claim 1, wherein

said thermal fuse includes therein a rod-shaped fuse.

ABSTRACT

Electronic components are integrated onto the front surface of a circuit board 1 having an interconnection pattern formed thereon. In the vicinity of a particular electronic component (FET) 2 among those components that is likely to generate heat, a thermal fuse 4 is provided for breaking circuit when the temperature of this electronic component increases. In the circuit board 1, a through opening 1a is provided in the area where the FET 2 is located. The FET 2 is attached to the front surface of the circuit board 1 to extend across the through opening 1a. On the rear side of the FET 2, the thermal fuse 4 is attached to partially enter the through opening 1a via a heat-conducting resin 3 such as silicone resin. This structure thus obtained for mounting the thermal fuse on the circuit board enables reduction of the thickness to the surface of mounted components without thinning the circuit board, enables a thermal fuse to be mounted on any circuit board which is to be housed in an extremely small space like the one in a notebook computer, and ensures breaking of circuit when abnormality occurs by sensitively detecting the temperature of any component which readily increases in temperature.

FIG. 1A

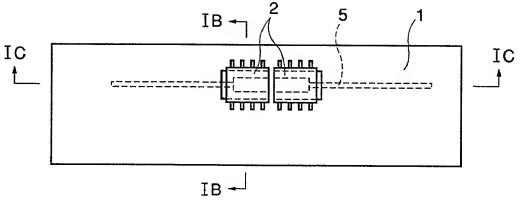


FIG. 1B

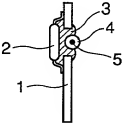


FIG. 1C

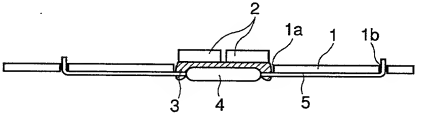


FIG. 1D

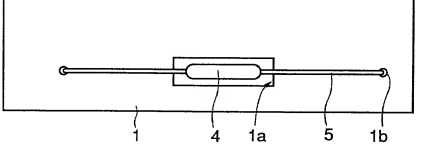


FIG. 2 PRIOR ART

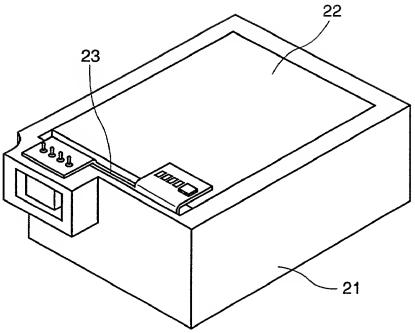


FIG. 3A PRIOR ART

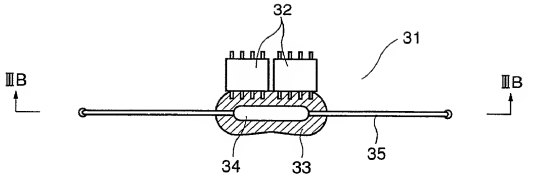
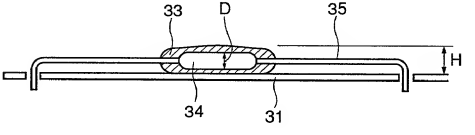


FIG. 3B PRIOR ART



PTO/SB/106 (8-96)
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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。	As a below named inventor, I hereby declare that:
私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。	My residence, post office address and citizenship are as stated next to my name.
下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。	I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
	Mount Structure for Thermal Fuse on Circuit Board
上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、	the specification of which is attached hereto unless the following box is checked:
☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、（該当する場合）_____ に訂正されました。	☒ was filed on April 30, 1999 as United States Application Number or PCT International Application Number PCT/JP99/02360 and was amended on _____ (if applicable).
私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。	I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.
私は、連邦規則法典第３７編第１条５６項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。	I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

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(日本語宣言書)

私は、米国法典第３５編１１９条(a)-(d)項又は３６５条(b)項に基き下記の、米国以外の国の少なくとも一ヵ国を指定している特許協力条約３６５(a)項に基ずく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Not Claimed 優先権主張なし
10-133248(P)	Japan	15/May/1998	☐
			☐

私は、第３５編米国法典１１９条(e)項に基いて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第３５編１２０条に基いて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約３６５条(c)に基ずく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第３５編１１２条第１項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第３７編１条５６項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)
(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自身の知識に基ずいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基ずく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第１８編第１００１条に基ずき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣誓を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration
(日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。（弁護士、または代理人の氏名及び登録番号を明記のこと）

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith *(list name and registration number)*

And I hereby appoint as principal attorneys:

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(Supply similar information and signature for third and subsequent joint inventors.)